PATENT SPECIFICATION (11) 1 501 047

1 501 047

(21) Application No. 10754/76 (22) Filed 17 March 1976
(31) Convention Application No's
7 511 343 (32) Filed 11 April 1975
7 538 064 12 Dec. 1975 in
(33) France (FR)
(44) Complete Specification published 15 Feb. 1978
(51) INT. CL.[2] B66F 3/24
(52) Index at acceptance
B8J 11 19B

(54) PNEUMATIC JACK FOR VEHICLES

(71) I, PIERRE JOSEPH PINGON, a French citizen of 7 Avenue du Parmelan Annecy (Hauts Savoie), France do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to vehicle jacks.

Usually, vehicle jacks have screws or toothed racks acting upon levers, generally linked together, subsequently transmitting their forces to the vehicle. These screws or toothed racks are moved by mechanical parts such as cranks which take their energy from the user of the jack. (French Patent No. 718,235 and U.S. Patent No. 1,544,997). Because of the low mechanical output of the screw-nut or screw-toothed rack system, the use of these jacks requires relatively large effort, and the jacks themselves are often cumbersome, heavy, dirty and difficult to use.

In order to overcome these disadvantages, jacks have been proposed which in use are actuated by a compressed gas cartridge (French Patents Nos. 552,926, 737,893, 1,427,118 and 2,092,838 and U. S. Patent No. 3,523,679). Nevertheless, these jacks have hitherto been made in the form of simple or compound jack cylinders or a bellows, of which the parts which move relative to one another under the action of the gas coming from the cartridge are placed directly between the surface forming the support and the vehicle to be lifted.

Now, to be usable in practice, a pneumatic jack must be actuated by a cartridge of relatively small size, and thus having a limited volume of compressed gas, and it should moreover provide a progressive and as far as possible a steady lifting movement of the vehicle, whilst the compressed gas in the cartridge expands in the volume of the jack cylinder as the latter grows, and consequently supplies a force varying from a high value at the beginning of the movement to a low value towards the end of the lifting, when the volume of the jack cylinder reaches a maximum.

In addition such a jack should be of small size, particularly in height, in the folded position, in order that it can be inserted without difficulty under the frame of a vehicle with a flat tyre, and it should be easy to handle and position.

The object of this invention is to create a pneumatic vehicle jack which overcomes the disadvantages of jacks which use the above principle, and which fulfils those conditions.

According to the present invention there is provided a pneumatic vehicle jack comprising a pneumatic jack cylinder, means for the detachable fitting of a cartridge of compressed gas on one part of the jack and means for connecting the interior of the gas cartridge to the pressure chamber of the cylinder for operating the jack, whereby the force exerted by the jack cylinder is reduced progressively when the volume of its pressure chamber increases during the operation of the jack, and a lever system connected to the movable parts of the jack cylinder, for acting between the ground or other supporting surface and the vehicle to be lifted, the lever system providing a relatively low mechanical advantage at the beginning stage of the operation of the jack and a relatively large mechanical advantage during the last stage of the operation in order to moderate the variation in force applied by the jack cylinder.

According to a preferred embodiment of the invention, the jack cylinder consists of two parts movable relative to one another and forming the body and the piston rod assembly of the jack cylinder, the lever system comprises two levers pivoted to one part of the jack cylinder and located on either side of the longitudinal axis of the said jack

cylinder and carrying shoes for engaging a support surface and a vehicle to be lifted and two struts pivoted on the one hand to the other part of the jack cylinder and on the other hand to each lever, the arrangement being such that operation of the jack cylinder causes the pivot points of the levers and struts with respective parts of the jack cylinder to be brought closer together which, through the action of the struts causes the levers to be pivoted and their shoes moved away from one another.

By giving the operating levers a U-shaped right angled section so that the operating levers, when in the folded position, surround the jack cylinder, a compact unit may be obtained of small height and in which the more fragile movable parts, such as the piston rod of the jack cylinder or the struts, and also the pivot points are protected.

When the jack is actuated, the force of the jack cylinder is transmitted by the struts to the operating levers, causing them to move apart by the drawing together of the pivot points of these operaing levers and of the struts on the parts of the jack cylinder. In the folded position, the struts form an acute angle with one another, and they then act on the operating levers in these conditions as a weak lever arm or mechanical advantage in relation to the pivot points of these levers on the jack cylinder, so that the lifting force of the jack represents only a small part of the force of the jack cylinder. When the jack expands, the angle between the struts opens out, and the force of the jack cylinder is then transmitted by the struts to the levers with the shoes in an amplified manner, as a result of the efficient lengthening of the lever arm. On the other hand, given that the compressed air in the cartridge occupies an increasing volume in the jack cylinder, the force of the jack cylinder lessens as the jack expands. As a result of the above indicated condition, a more uniform lifting force is provided by the jack.

In order to facilitate the handling of the jack, the body of the jack cylinder may, according to one form of the invention, be tubular in shape and project at one side to make a handle, making the positioning of the jack easier, the compressed air cartridge being fitted into this tubular shaped jacking cylinder.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings in which:—

Figure 1 is a view in section, with the cut taken along line I-I in Figure 2, of one possible form of the jack according to the invention;

Figure 2 is a view of the end of the jack shown in Figure 1, with the cut taken along the line II-II in Figure 1;

Figure 3 is a longitudinal section of a preferred form of the jack according to the invention, the jack being at rest;

Figure 4 is a transverse section along the line IV-IV in Figure 3; and

Figure 5 is an elevation of the jack shown in Figure 3, in expanded position.

According to the form of the invention shown in Figure 1 and Figure 2, the jack comprises a motive part 1 linked with a part marked 2 which ensures the transmission of the forces developed in the said motive part 1 between the support surface adjacent shoe 3 and the vehicle to be lifted adjacent shoe 4.

The motive part 1 comprises essentially a one-way jack cylinder consisting of a cylindrical tubular element 5 fitted with a base 6 at one of its ends. Within this tubular element, and sliding against its inner wall 7, moves a piston 8 together with a piston rod 9, which slides making a tight seal in a cylindrical opening 10 in the base 6. Along almost the entire length of the piston rod 9 is a bore 11. A hole 12 near the region of the junction of the piston rod 9 with the piston 8, makes communication between the axial bore 11 of the piston rod 9 and the working chamber 13 of the jack cylinder possible. The left hand end (looking at Figures 1) of the piston rod 9 has a cylindrical threaded hole 14 whose purpose will be described later. Also at the left hand end, the bore 11 is extended by means of a passage 15, within which is fixed a hollow needle 16 forming a plunger, whose purpose will likewise be described later. The usual sealing methods ensure sealing of the fluid pressure system at all points.

On either side of the piston rod 9 near the left hand end are provided pins 17 and 18 which are made integral with the rod by soldering, brazing or other methods, thus forming a pivot axis 32 perpendicular to the axis of the piston rod 9.

A cartridge 19 formed by a cylindrical metal tube 20 is sealed at both ends (looking at Figure 1) by two stoppers 21 and 22 respectively. These latter may be of plastics material and are inset into the tube. Inside the cartridge is air under high pressure. In the central part of the right hand stopper 22 is a cylindrical bore, which widens out towards the interior of the cartridge at 23 to form a seat for a ball-bearing valve 24. The ball valve 24 is able to bear against the surface of the bore at this point 23 in order to seal the bore placing the pressurised cartridge chamber out of communication with the outside. The face of the right hand stopper 22 that is directed outwards is extended by a threaded boss, which will screw into the corresponding threaded hole 14 at the left hand end of the piston rod 9.

The forces supplied by the jack cylinder are transmitted to the vehicle by the part marked 2 of the jack. The part 2 comprises principally two levers 25 and 26 each pivoting, on the one hand, at their common end, about the axis 32 as defined by the pins 17 and 18, and on the other hand, at a point distant from the aforesaid end, at the end of the small struts 34, 35 which are themselves pivoted by their other end at 31 on the body 5 of the jacking cylinder.

These levers 25 and 26 have a general section in the form of a U and are made of bent sheet metal. The spacing of the limbs of the U are not equal in order to permit the nesting of the first lever 25 between the limbs of the U of the second lever 26. The ends of these levers pivoted about the axis 32 are fitted onto the pins 17, 18 by means of the holes 27 and 28, 29 and 30. The back of the levers is directed outwards so as to enclose the body of the jack cylinder between the parallel limbs of the U-shaped levers.

The small struts 34 and 35 may be of any type. They are suitably pivoted on the pins 31 of the body 5 of the jacking cylinder. The pivot points 36, 37 of these small struts on the U-section levers, the length of the small struts and the positions of the axes 31 and 32 are contrived in order to provide a suitable geometry for the use envisaged.

The shoes 3 and 4 are likewise mounted on pivots at the right hand ends (on the diagram) of the levers, so that they may engage against the vehicle to be raised on the one hand, and on the support surface or ground on the other.

The jack functions as follows:—

When a cartridge of compressed air is screwed onto the end of the piston rod, the hollow needle 16 separates the ball bearing 24 from its seating, thus connecting the inside of the cartridge with the chamber 13 of the jack cylinder via the bore 11 and the passage 12. Thus the piston moves relative to the body of the jack cylinder. When this movement occurs tending to reduce the distance between the two pivot axes 31 and 32, the levers 25 and 26 pivot and their right hand ends move away from each other. As a result of this separation, the distance between the shoes 3 and 4 increases, raising the vehicle. It will be realised that the pneumatic system formed by the cartridge and the chamber of the piston is a closed system which maintains the vehicle in raised position.

The preferred form of the invention shown in Figures 3 to 5 comprises a jack cylinder 38 provided with a body 39 into which slides a piston 40 having a piston rod 41. The body 39 of the jack is formed from a tubular part which is closed at one end by a base 42 secured by a stop ring 43, the chamber 44 of the jack cylinder being created between the base 42 and the piston 40. The rod 41 of the piston is screw-fitted into the piston.

The body 39 of the jack cylinder has a rectangular block 45, better shown in Figure 4, secured by a stop ring 46. This block is traversed by the pivot axes 47 perpendicular to the longitudinal axis of the jack cylinder, on which are pivoted the operating levers 48 having a generally U-shaped cross section, the open sides of the levers being opposed to create, when folded together a rectangular housing in which are placed the parts of the jack, as shown in Figure 3. At their ends opposite to the axes 47, the levers 48 have shoes 49 for the purpose of acting between the ground and the vehicle to be raised.

Struts 50 are pivoted on the one hand on a part 51 screwed to the free end of the piston rod, by means of an axis 52, and on the other hand on the operating levers 48, by the axes 53.

As can be seen in Figures 3 and 5, the body 39 of the jack cylinder extends beyond the pivot block 45 of the levers 48, away from the piston rod, so as to form a handle making it possible to hold the jack when it is in use.

Within the case formed by this handle, the piston 40 provides a housing 54 which has a threaded section into which can be screwed a cartridge of compressed air 55 for the purpose of operating the jack.

At the end of the piston rod nearest the piston is a needle 56 which, when the cartridge 55 is put in place, actuates the valve of this cartridge, to admit compressed air into the jack cylinder. A channel 57 in the piston rod 41 establishes communication between the needle 56 and the chamber 44 of the jack cylinder.

The operation of this particular form of jack according to the invention is similar to that of the jack described above.

In the starting position shown in Figure 3, the operating levers are virtually parallel and closed about the parts of the jack, protecting them. Thus the jack is of minimal height, which makes it easier to position beneath the vehicle. The piston rod of the jack cylinder is in the extended position and the separation between the axes 52 and 47 is at maximum. The handle formed by the body 39 of the jack cylinder 38 facilitates the positioning of the jack beneath the vehicle.

When the cartridge of compressed air is screwed into place, communication is made between this cartridge and the chamber 44 of the jack cylinder. The pressurising of this chamber 44 causes the piston 40 of the jack cylinder to move to the left, looking at Figure 3.

The forces exercised by the piston rod 41 on the pivot axis 52 and on the struts 50 are shown by arrows on Figure 3. At the beginning of the operation, the force supplied by the jack cylinder is at a maximum, as is the pull exerted on the axis 52. This force is transmitted to the struts 50. However, it acts on the operating levers 48 via a lever arm which is very short relative to the pivot axes 47 of these levers on the body of the jack cylinder and this provides a relatively low mechanical advantage. Under these conditions, the resultant lifting force of the jack is less than that supplied by the jack cylinder.

As the jack expands, the effective lever arms via which the struts act on the operating levers increase, providing a relatively large mechanical advantage and the resultant lifting force of the jack approaches that of the jack cylinder itself, and then surpasses it as the final expanded position of the jack shown in Figure 5 is neared.

But given that the volume occupied by the compressed air from the cartridge 55 increases, since the volume is made up of the sum of the volumes of the cartridge and the chamber 44, the force of the jack cylinder itself decreases. Thus, the mechanical advantage of the jack and the force of the jack cylinder itself vary in opposite senses, and as a result of this, a virtually constant resultant lifting force is achieved for the jack, and consequently an appreciably uniform lifting movement of the vehicle.

Examination of Figure 5 will show that a jack thus constructed has a considerable height when in the expanded position, and that the lifting path which results from the difference in heights between the rest position shown in Figure 3 and the operating position shown in Figure 5, is itself of notable extent.

Modifications can be made to the forms of the invention described, within the range of equivalent techniques, without departing from the invention as claimed.

WHAT I CLAIM IS:—

1. A pneumatic vehicle jack comprising a pneumatic jack cylinder, means for the detachable fitting of a cartridge of compressed gas on one part of the jack and means for connecting the interior of the gas cartridge to the pressure chamber of the cylinder for operating the jack, whereby the force exerted by the jack cylinder is reduced progressively when the volume of its pressure chamber increases during the operation of the jack, and a lever system connected to the movable parts of the jack cylinder, for acting between the ground or other supporting surface and the vehicle to be lifted, the lever system providing a relatively low mechanical advantage at the beginning stage of the operation of the jack and a relatively large mechanical advantage during the last stage of the operation in order to moderate the variation in force applied by the jack cylinder.

2. A pneumatic jack according to claim 1, in which the jack cylinder consists of two parts movable relative to one another and forming the body and the piston rod assembly of the jack cylinder, the lever system comprises two levers pivoted to one part of the jack cylinder and located on either side of the longitudinal axis of the said jack cylinder and carrying shoes for engaging a support surface and a vehicle to be lifted and two struts pivoted on the one hand to the other part of the jack cylinder and on the other hand to each lever, the arrangement being such that operation of the jack cylinder causes the pivot points of the levers and struts with the respective parts of the jack cylinder to be brought closer together which through the action of the struts causes the levers to be pivoted and their shoes moved away from one another.

3. A pneumatic jack according to claim 2, in which the positions of the pivot points of the levers and the struts on the parts of the jack cylinder are such that when in the lowered position the levers are substantially parallel to each other, the levers having U-shaped cross-sections with the open sides opposed and enclosing, at least partially, the jack cylinder and the struts when in the lowered position.

4. A pneumatic jack according to claim 2 or 3, in which the levers are pivoted on the piston rod of the jack cylinder, the struts being pivoted between the levers and the body of the jack cylinder.

5. A pneumatic jack according to claim 4, in which the levers are pivoted on a common axis.

6. A pneumatic jack according to claim 2 or 3, in which the levers are pivoted on the body of the jack cylinder, whilst the struts are pivoted between the levers and the piston rod of the jack cylinder.

7. A pneumatic jack according to claim 6, in which the operating levers are pivoted on axes fixed to a rectangular block on the body of the jack cylinder.

8. A pneumatic jack according to any one of claims 2 to 7, in which the means for the detachable fitting of the cartridge of compressed gas are provided at the free end of the piston rod, and a longitudinal channel is made in the piston rod connecting the cartridge of compressed gas with the chamber of the jack cylinder in order to operate the jack.

9. A pneumatic jack according to any of claims 2 to 8, in which the piston of the jack cylinder has a housing in the section opposite the piston rod, into which the cartridge of compressed gas can be fitted.

one or more channels or passages being provided between the housing and the chamber of the jack cylinder, for the operation of the jack.

10. A pneumatic jack according to claim 9, in which the body of the jack cylinder is tubular in shape and projects from the end opposite the piston rod, beyond the pivot points for the operating levers fixed onto this body, in order to form a handle allowing the jack to be held when being positioned and surrounding the part of the piston into which the cartridge of compressed gas fits.

11. A pneumatic jack according to claim 9 or 10, in which a hollow needle is connected to the channel or channels, passage or passages leading to the chamber of the jack cylinder, which in use actuates a valve in the cartridge of compressed gas when the cartridge is fitted into its housing.

12. A pneumatic jack substantially as described hereinbefore with reference to the accompanying drawings.

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Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1978.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1501047 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

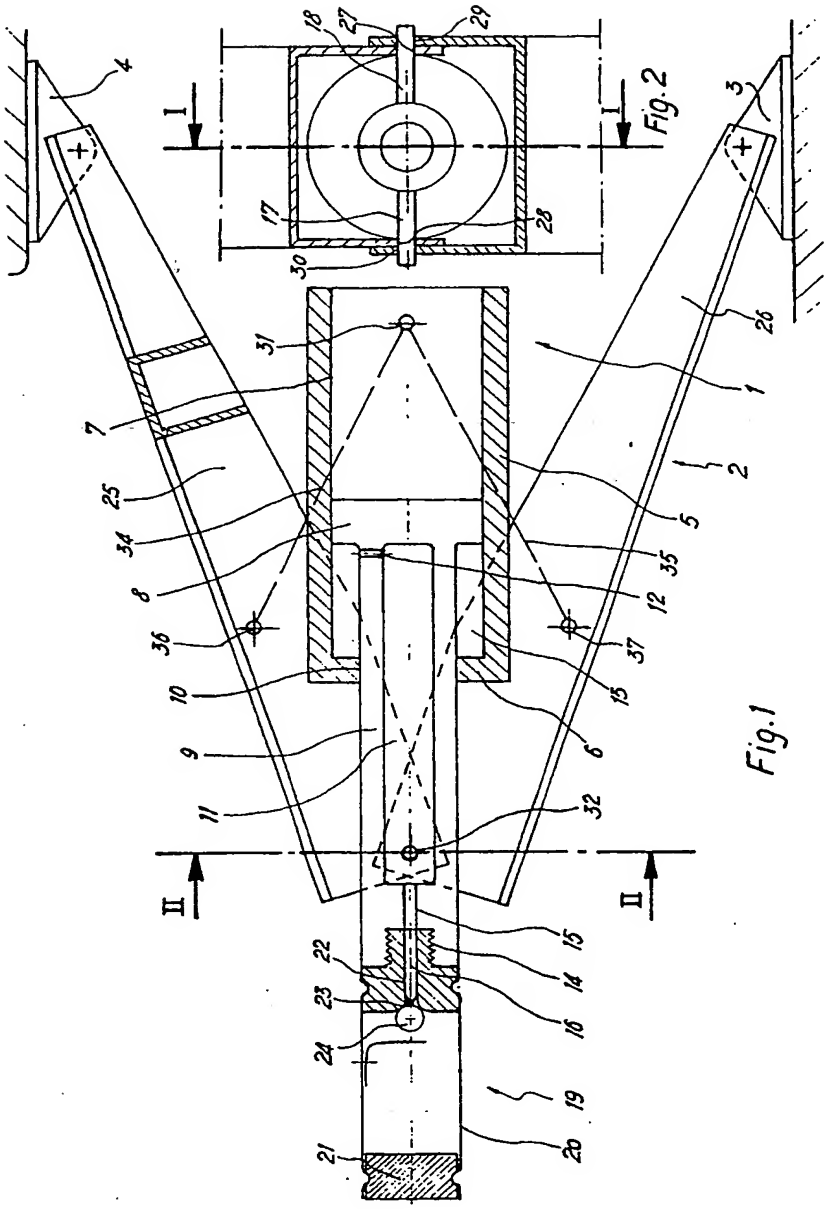

Fig.1

1501047 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 2

Fig. 3

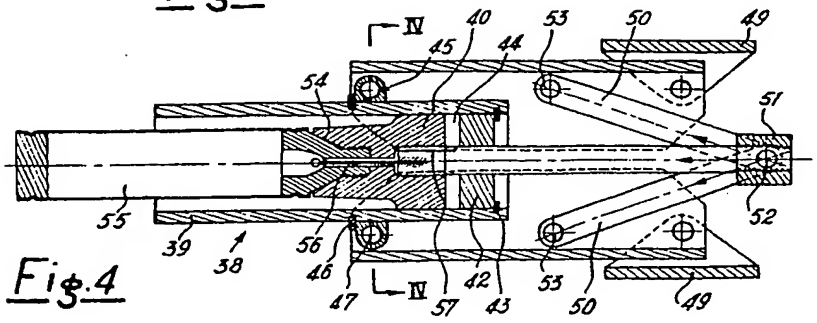

Fig. 4

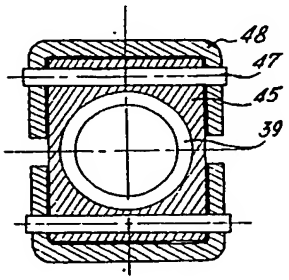

Fig. 5